ON SPRAY PRODUCERS

AS USED IN

LISTER'S ANTISEPTIC SYSTEM;

WITH AN ACCOUNT OF THEIR ORIGIN, AND WITH HINTS FOR THEIR SELECTION AND MANAGEMENT.

BY

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With Thirty-eight Woodcuts.

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ON SPRAY PRODUCERS.

As is well known, one of the leading features of Lister's antiseptic treatment of wounds is the exclusion from them of the exciting causes of putrefaction. To insure this it is necessary that the atmosphere surrounding them be freed from the germs and noxious particles which are constantly present, and have the power of imparting to serous or purulent fluids those septic or fermentative changes which are known as *putrefaction*, and which carry in their train such a host of evils. Without going into a history of the means adopted, from time to time, to obtain this germless, and, consequently, harmless atmosphere, I may say that at present it is brought about by the use of spray producers, which emit a spray of carbolic acid large enough to envelop any wound, both at the time of its infliction and at any other time that it may be necessary to remove its antiseptic dressings and expose it to the air. In this paper I propose to give some accounts of the instruments usually employed for this purpose, but I have thought that it would make the subject more complete, and perhaps more interesting, were I to incorporate with it some account of the first attempts at the atomisation of fluids. Accordingly, I shall arrange my remarks under the three following heads:—1. A short history of the origin and progress of spray producers. 2. A description of some of the most approved instruments at present constructed for carrying out Lister's system. 3. Some general remarks on the selection and management of spray producers.

1. *History of the Origin and Progress of Spray Producers.*—This section of my paper is so intimately associated with the question of medicinal *inhalations*, that I must briefly introduce that subject. From the earliest times the value of

local applications to the mucous membrane of the respiratory tract was recognised by medical men, and with *volatile* substances there was no great difficulty in carrying out this line of treatment, each practitioner adopting, in a great measure, his own particular plan. Thus, Hippocrates tells us (*De Morbis*, lib. ii, sec. v) that he was in the habit of employing an apparatus which "consisted of a pot, the lid of which had an opening for the reception of a reed, through which the vapour escaped and was inhaled through the opened mouth: the latter being protected from scalding by moistened sponges." (Beigel.) Any such procedure, however, was quite useless in the case of *non-volatile* substances, many of which were known to be of great therapeutic value. Some physicians, as Aretæus, tried to overcome the difficulty by blowing the medicinal substances through a tube, just as is done in the present day in treating affections of the middle ear, while in more recent times, at some watering places they attempted to create an atmosphere suffused with mineral water for inhalation. Such a plan, as may be supposed, only resulted in furnishing a simple vapour bath for the patients, as there could be no medicament in the water. The first practical suggestion for the atomisation or minute division of liquids holding *non-volatile* substances in solution came from M. Auphan, at the Spa of Euzet les Bains. Bearing in mind that water exists in the form of spray, when dashed with violence on hard bodies, as in waterfalls and in the breakers of the sea-shore, he conceived the idea that the water at the mineral spring might be *atomised* by directing a jet of it forcibly against the walls of the apartment for inhalation. This was the first real attempt at *atomisation* of fluids, and the method was adopted in other continental spas, coming into pretty extensive use at the different watering places. It was, however, a coarse and ineffective way of accomplishing the object aimed at, and one quite unsuitable for private practice. Under these circumstances, M. Sales-Giron, a medical man at Pierrefond, in France, directed his attention to the matter, and taking up the idea of M. Auphan he worked at it for some years, and at length, in the year 1858, he was enabled to lay before the Academy of Medicine, at Paris, *a portable inhalation apparatus*, whereby medicated fluids, either volatile or non-volatile, could be dispersed in the form of a fine spray, and thus be made available for treating diseases of the respiratory organs. The accompanying woodcut, Fig. 1, shows the instrument of Sales-Giron. He termed it his "Pulvérisateur portatif des liquides medicamenteux." It consists of a vessel filled with the fluid to be atomised, while above it is placed an air-pump, A, which compresses the air above the surface of the water, the pressure being indicated by a manometer, C. When the instrument is at work the fluid escapes through the fine opening of a tube with a stopcock, D, and strikes against a small metal disc, E, where it is broken and turned into a very minute vapour, any of the condensed vapour escaping through a small tube, G. The exhibition of this apparatus of Sales-Giron before the Academy, raised the question as to whether or not this *pulverised fluid*, as it was termed, could reach the bronchial tubes, and when, after careful enquiry, it was decided that it could do so, the full value of the invention was seen, and we find Trousseau stating "that Sales-Giron has rendered a great service to the world at large by his invention of the treatment by pulverisation." Indeed, we may be said to owe the inhalation of *atomised fluids* to Sales-Giron, just as we are indebted to Dr. Alexander Wood, of Edinburgh, for the hypodermic injections of medicines. As was to be expected, Sales-Giron's instrument underwent various modifications, but the principle was the same in all, and consisted in forcibly impelling a jet of liquid through a capillary orifice against a small metallic disc or button, by which it was broken up into minute particles.

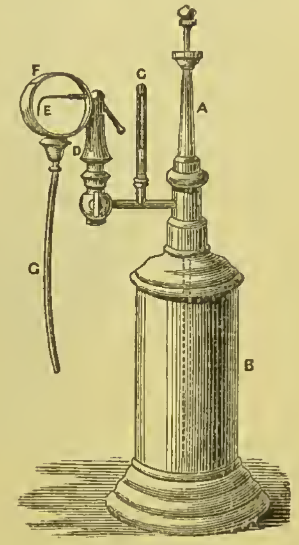

Fig. 1.

In the following year, 1859, we find M. Mathieu, of Paris, contributing a new idea for obtaining the pulverisation of fluids. He exhibited his apparatus to the Academy of Medicine at Paris, and termed it Nephogène. In it the subdivision of the medicated fluids is brought about, not by checking the jet against a solid body, but by forcing the fluid to escape at high pressure, along with a blast of compressed air, through a tube with a small opening. Fig. 2 shows Mathieu's original instrument. In it the air is compressed in the brass ball, A, by means of the pump above it, whilst the fluid to be atomised is put into the glass ball, B. As soon as the instrument is set in motion the two stopcocks are opened, when the medicated fluid escapes drop by drop into the tube C, and there meets the blast of compressed air, which forcibly projects it outwards in the form of a very fine but cold spray.

All the instruments for pulverisation of fluids which were constructed before the year 1862 were made either on this principle or on that of Sales-Giron, but in that year there was brought forward by Dr. Bergson, of Germany, an important modification in the mechanism necessary for carrying out Mathieu's idea. Bergson called his instrument "Hydrokomion," or "Water Dust Apparatus," and in the accompanying woodcut, Fig. 3, I give an illustration of it. It consists essentially of two glass tubes, with capillary openings at one end, placed at right angles to each other. The open end of one tube dips into a vessel filled with the fluid which is to be subdivided, A, while the other, D, is fastened to a caoutchouc tube, about a yard long, having on it two globular or spindle-shaped expansions, one in the middle, B, representing an air reservoir, and the other at the end, C, a pair of bellows. If this latter ball is pressed by the hand, the air in the middle ball is compressed and is forcibly blown through the horizontal tube, D. As the current escapes from the fine orifice of this horizontal tube it passes over the mouth of the other tube, creating in it a vacuum, or a tendency to a vacuum, as a consequence of which, first the air in the tube and afterwards the liquid in which it is immersed rises, and becoming thor-

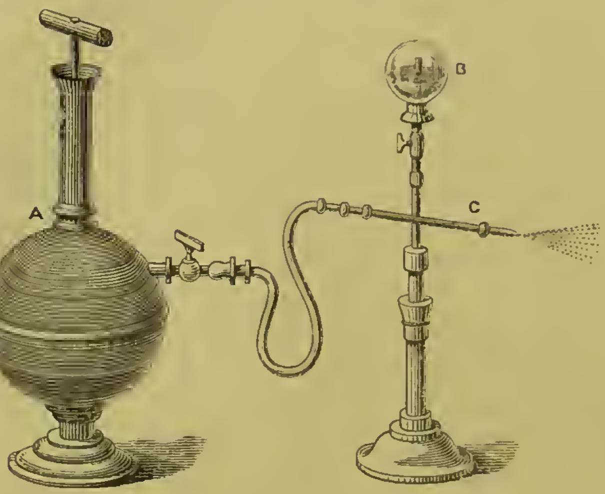

FIG. 2.

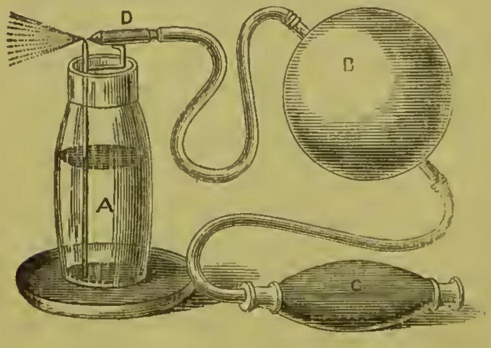

FIG. 3.

oughly mixed in an atomised state with the air is driven forward with it in a constantly expanding jet of spray. The success of this arrangement was soon ensured, and as we shall see farther on, it has served as the model for different spray producers of more recent date. Dr. Bergson seems to have had the idea of these tubes suggested to him by a Dr. Natanson, and their motive principle is the same as that embodied in Gifford's steam injector for feeding boilers; but he undoubtedly was the first to bring them out in connection with the subject of atomising fluids, and accordingly they are still known by his name. They are familiar to us in the "*odorateurs*" sold for blowing perfumes about a room: and the original Bergson's tubes, as shown in the woodcut, Fig. 4, were made of glass, of about the diameter of a goose quill, and were fixed in their due relative position by a sort of glass elbow, C, extending from one to the other.

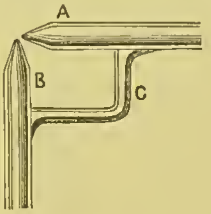

FIG. 4.

Bergson's development of Mathieu's principle was, however, soon to receive a further elaboration in the substitution of vapour or steam for atmospheric air. This idea was brought prominently before the public by Dr. Emil Siegle of Stuttgart, who took out letters patent for a *steam spray producer for inhalation* on April 22nd, 1864, and in a work published in the same year (A. Kroner, publisher, Stuttgart) he describes his instrument. I give here an illustration of it in its original form, Fig. 5, from which it will be at once apparent that what Siegle did was to connect Bergson's spray tube with a glass boiler, using steam for producing and conveying the spray instead of air. I know it is a moot question as to whether or not Siegle was the first to employ steam in that capacity, for in the *Allg. Med. Centralzeitung*, No. 42, 1862, Dr. H. Waldenburg, of Germany, described an instrument by means of which he could produce medicated spray *in combination with steam and through the motive power of that principle*, but his apparatus was entirely different from that of Siegle's. Whether or not Siegle had ever seen Waldenburg's paper I cannot say. If he had, he worked out the idea differently, utilising, as we have seen, Bergson's tubes. Siegle's spray, however, as originally made with its glass boiler and thermometer, Fig. 5, had many defects, and it was subjected to a good deal of criticism, as a consequence of which various improvements were instituted, one of the chief of which was the adoption of an improved boiler. This latter was no doubt borrowed from an inhaler which was brought out by Dr. Adams of Glasgow in the year 1868. Space does not allow me to go into the many advantages possessed by this boiler, but they are very fully enumerated by Dr. Adams in a paper in the *Glasgow Medical Journal* for March, 1879. Fig. 6 shows a sectional view of Adam's inhaler, and that it is the model on

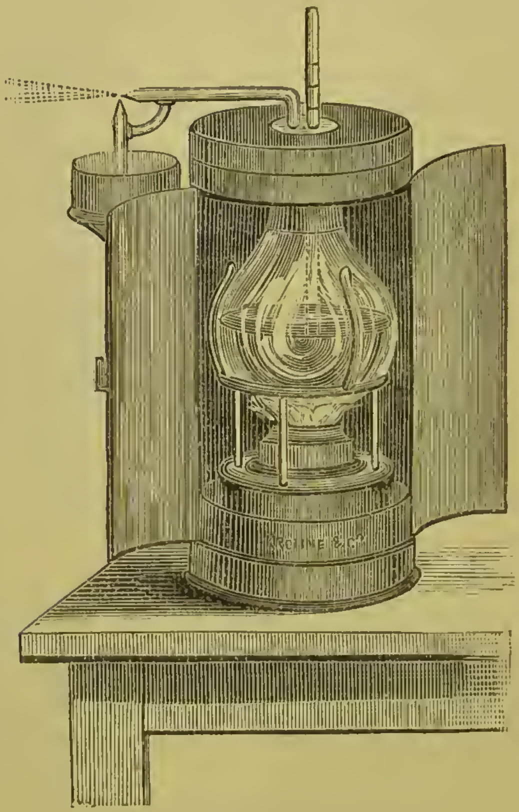

Fig. 5.

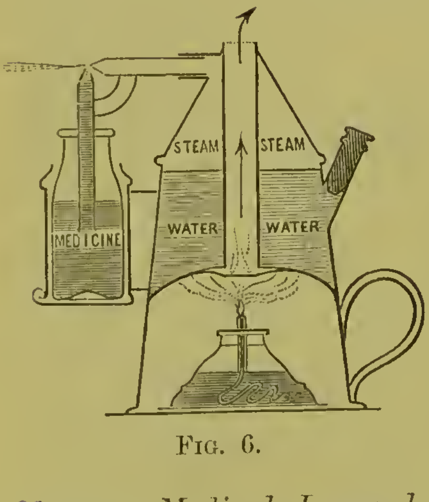

Fig. 6.

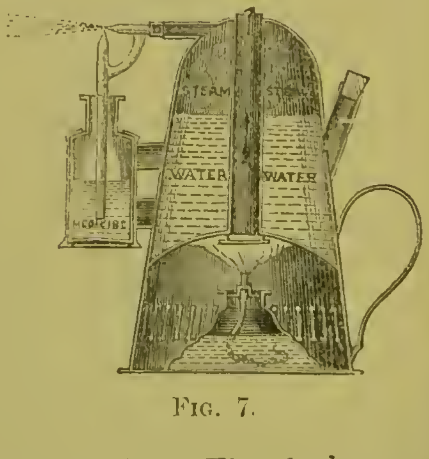

Fig. 7.

which Siegle's later instruments were made is clear from Fig. 7, where we have represented a section of Siegle's improved inhaler. Experience soon showed that steam sprays had a good deal to recommend them, especially as compared with those in which the dispersing power is compressed air, for it was found that they gave off a steady uniform stream of spray, warm in character and so fine as to cause little irritation, while, being self-acting, they neither fatigued the patient nor required an assistant. In this way they became extensively used.

Meanwhile, Bergson's tubes were also becoming more widely known among English practitioners, in a great measure through the exertions of Dr. Andrew Clark, of London, who was anxious to have an instrument that would give a *continuous spray*, and with this view he had a pair of Bergson's tubes fitted into the cork of a graduated glass bottle, and had attached to them a double hand bellows with suitable valvular arrangements which allowed of a constant spray being kept up for an indefinite time. This instrument was made for him by Krohne & Sesemann in the spring of 1865, and has since been known as Clark's spray producer. It is seen in Fig. 8, and it will be at once recognised as merely an improved edition of Bergson's original idea.

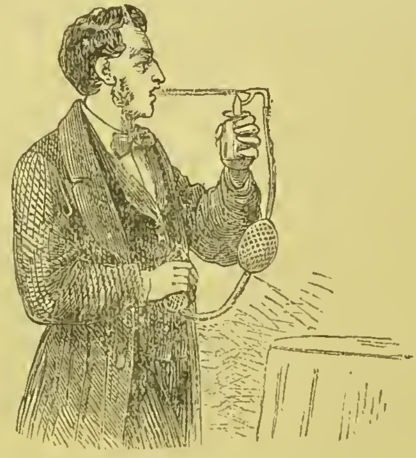
FIG. 8.

It is right, however, that I should state that the above account of the course of events is not quite in keeping with that given me by Messrs. Krohne & Sesemann. They claim for Clark's spray producer the distinctive feature that it was the first apparatus to which a *double* hand bellows was attached, and that Bergson's original instrument was worked with a *single* ball. I have tried to get the paper in which Bergson first published his suggestion, but I have been unable to do so. All the writers, however, whom I have consulted speak of the original Bergson as having a double hand bellows, and in Fig. 3 I give an illustration of it from Beigel. Under these circumstances all I can do is to give Krohne & Sesemann's statement and leave the matter at present open. There seems no doubt that the netting placed over the second ball in the double hand bellows is the suggestion of that firm of instrument makers.

What tended as much as anything to spread a knowledge of the double hand bellows as a motive power for working spray producers, was the appearance of Dr. Richardson's ether spray for producing local anæsthesia. This instrument, Fig. 9, was brought out in January, 1866, also by Krohne and Sesemann, and soon became very generally known. In its mode of action it follows more the principle of Gifford's steam injector, and consists of a graduated bottle for holding the ether, while through a perforated cork a *double* tube is inserted, one extremity of the inner part of which goes to the bottom of the bottle. Above the cork, a little tube, connected with a hand bellows, pierces the *outer part* of the double tube, and by means of a small aperture at the lower part of this outer tube communicates with the interior of the bottle. The inner tube for delivering the ether runs upward nearly to the extremity of the outer

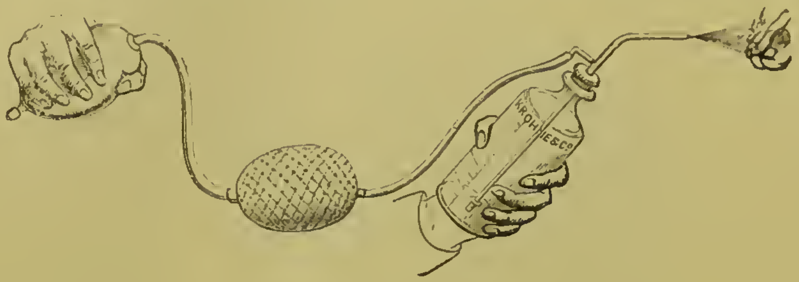

Fig. 9.

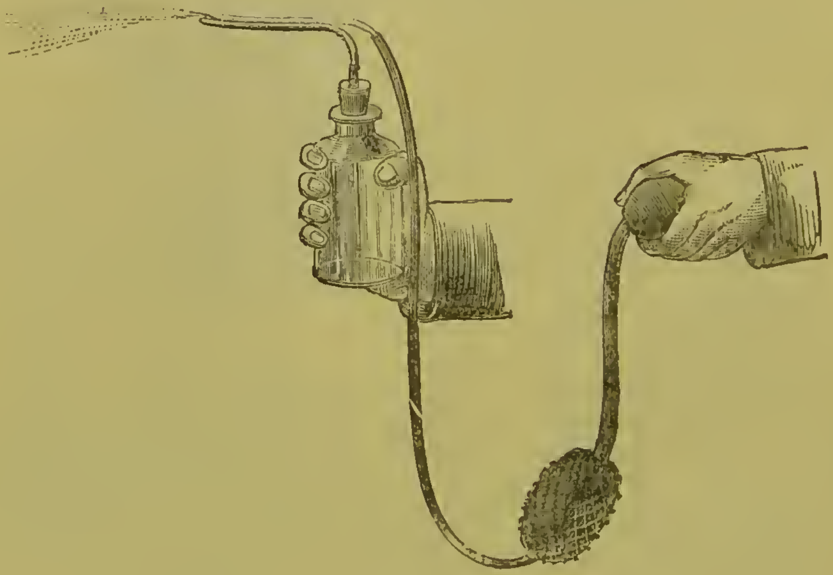

Fig. 10.

tube. When the bellows are worked, what takes place is this:—A double current of air is produced, one of which *descends* into the bottle and presses upon the ether, forcing it along the inner tube, while the other current *ascends* through the outer tube and plays upon the column of ether as it escapes through the fine jet. The size of the jet modifies the amount of the ether, and consequently the size of the spray. It is thus apparent that Richardson's spray, though atomising the fluid by incorporating it with a current of air after Mathieu's idea, differs in its construction somewhat from Bergson's instrument, though acting on the same principle. Dr. Richardson's instrument was some time afterwards followed by Dewar's spray producer, Fig. 10, connected with the great "sulphur cure." It was almost an exact imitation of Dr. Clark's, but differed from it in having the tubes elongated and made of vulcanite, with gold or silver points. Other forms of instrument have from time to time made their appearance, in some of which the tubes are arranged parallel, as shown in Fig. 11. This instrument is very portable and handy, and was devised by Dr. Brakenridge, of Edinburgh. In Fig. 12 is seen Dr. Prosser James' spray producer, made by Maw, Son, & Thompson, in which the tubes are also placed parallel to one another, but the upper tube at one end has a cup-like expansion for holding fluid, while at the other end it is bent perpendicularly downwards, with a capillary opening at the extreme point. By this arrangement gravitation is brought to favour the passing of the liquid to be atomised into the current of air. I need not pursue this part of my subject any further, as I think I have made it clear that the spray producers of later years, though modified in form, are

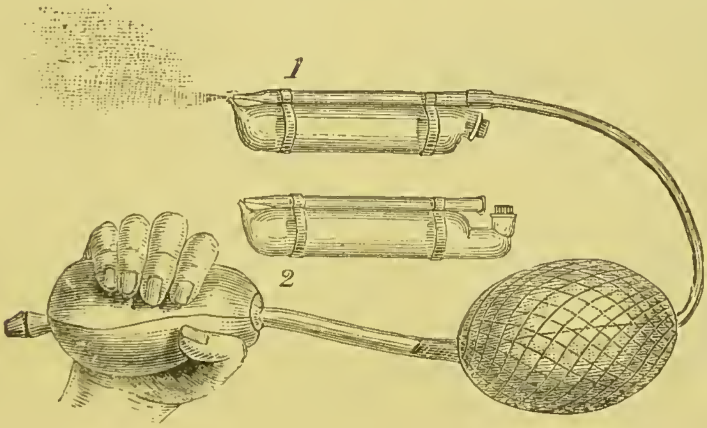

FIG. 11.

all more or less the outcome of the original, very simple, and ingenious apparatus devised by Dr. Bergson, and pourtrayed above in Fig. 3.

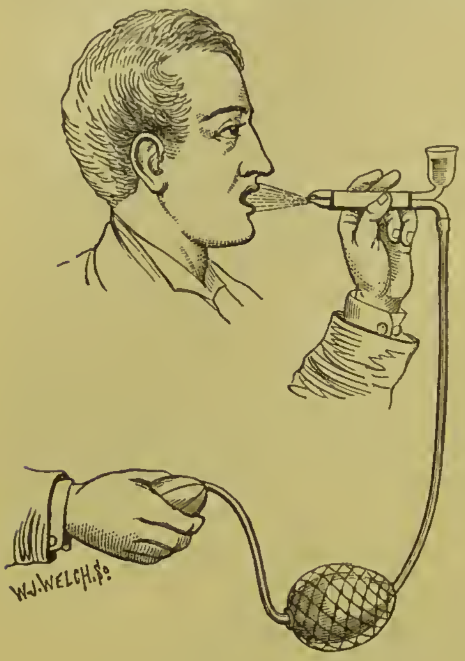

Fig. 12.

Such was the position of matters as regards spray producers when Mr. Lister turned his attention to utilising them in the carrying out of his antiseptic system. When the idea first occurred to him I cannot say, but the first published notice that we have of the use of the *gauze and spray* is in the *British Medical Journal* for 14th January, 1871. At first Richardson's ether sprays were used, and they answered very well, notwithstanding their small capacity, and the limited cloud of spray they produced. With the object of meeting these drawbacks, a larger hand spray was introduced, worked by the double hand bellows, and, from time to time, various modifications were made in it, chiefly at the suggestion of Mr. Lister. Thus, he had a break made in the air tube, and had it filled up with a piece of rubber-tubing to allow of its being compressed, so as to regulate the jet of liquid according to the volume and coarseness of the spray required. He suggested also the hood for protecting the points from injury, and the insertion of a bit of sponge in the lower end of the water tube to act as a filter, and prevent the points being blocked by particles of dust. Another very important alteration was the substitution, for a stopcock, of a small screw at the end of the water pipe, which allowed of the flow at the water jet being regulated. This simplified the manufacture of the tubes, and reduced the price. Sometimes accidents happened, owing to the tubes with the cork coming out of the bottle, which, if not held in the hand, fell to the ground, and was broken. To obviate this, Mr. Baldwin, when serving as dresser under Mr. Lister, had a wire guard made, which secured the cork in position while the instrument was in use. When all these alterations were carried out, together with the substitution of india-rubber corks for the spray bottles, the hand spray was a most serviceable one; and I sometimes think, looking back to the early days of antiseptics, that at present hand sprays are not appreciated as much as they ought to be. Did the length of this paper allow, I could point out many advantages belonging to them. When I speak of the antiseptic spray producers at present in use, I shall give an illustration of the instrument described above, showing the different improvements mentioned. One of the most marked changes, however, made in the construction of the sprays was the substitution of foot bellows instead of those worked by hand. This had been done as far back as 1867 by Krohne & Sesemann, and attached to Richardson's ether sprays for dental purposes, but Mr. Lister's adoption of them tended to popularise them, and I shall show afterwards an illustration of an apparatus known in the trade as Lister's foot spray producer. There was still a more important change to come yet, and that was the use of steam as the motor power in the formation of the spray. It was in the winter session of 1872-73 that Mr. Lister made the announcement at a clinical lecture, at which I was present, that he purposed using steam sprays in future, in the management of his cases, and he exhibited one of Siegle's in working order, and pointed out how it would answer. The small size of the Siegle was against its general use, for, though quite suitable for changing a dressing, it was quite useless for an operation. This led to the construction of larger instruments of more complicated character.

The instruments of the present day are, no doubt, most efficient in every way, but few know the labour gone through and the time spent in devising their shape and arrangements, so as to make them portable and reliable. Soon after commencing to construct them, it was found that doing so was an infringement of Siegle's patent, and an arrangement had to be come to, whereby, on payment of a certain royalty for each spray, the necessary liberty for making them was granted. It would be too long a story to go into all the difficulties encountered and overcome in the construction of what are now known as Lister's antiseptic spray producers, but there is one point that I must allude to, as it caused a great deal of trouble, and at one time threatened to interfere very materially with the usefulness of steam sprays. I refer to the difficulty experienced in providing a suitable lamp for the production of the steam. The first of the larger instruments were furnished with circular wicks like those seen in moderator lamps. These were made sometimes of cotton, at other times of metal gauze, so as to prevent their being burnt away, and they could be moved up and down by a rack movement. They were found, however, not to answer, as the vapour of the spirit was drawn up by the heat, and was at once set on fire whenever any movement of the spray took place, or any current of air affected the flame of the lamp, as a result of which explosions occurred, enveloping the instrument in flames and proving a terror to every one in the vicinity, to say nothing of the risk run in having perhaps to stop the spray at a critical part of an operation. With a view of remedying this state of matters, wire guaze was put round the lower part of all sprays, to break draughts and permit the instrument being carried about, and attempts were made to isolate the different parts of the lamp, as, for instance, the central part from that holding the spirit, by means of cylinders of glass, wood, vulcanite, asbestos, and other substances. All were found useless, and it was clear some other form of lamp would have to be got. A trial was next made of a lamp much used in France for boiling the contents of coffee machines, and consisting of a metal tube perforated with holes, and surrounded at its lower part by a circular wick. When this latter was lighted, the vapour of the spirit rose, and finding its way out at the holes at the top of the tube became ignited. This answered very well in some respects, but there was no way of lessening the flame, and so Mr. Lister devised what is termed the "snuffers lamp," in which the wick at the lower part of the tube could be put out by bringing the ends of the snuffers together. But in connection with them was a small wick which still kept lighted, and when it was desired to rekindle the larger wick it was only necessary to separate the snuffers and bring the small wick into contact with it. Some sprays are still made with the snuffers, but they have been more or less replaced by a better arranged lamp, which we owe to Mr. Chiene, of Edinburgh, and which is known as "Chiene's lamp." It has undergone one or two modifications since it first came out, but in its present approved form it is composed as shown in diagram, Fig. 13. It consists of an upright burner tube, B, having a closed top, and provided with a number of fine holes all round just below the top. This burner tube fits into the closed spirit receptacle, A, and is furnished with a lateral air chamber, C, against the under side of which, the flame from a small wick burner, D, with a movable joint,

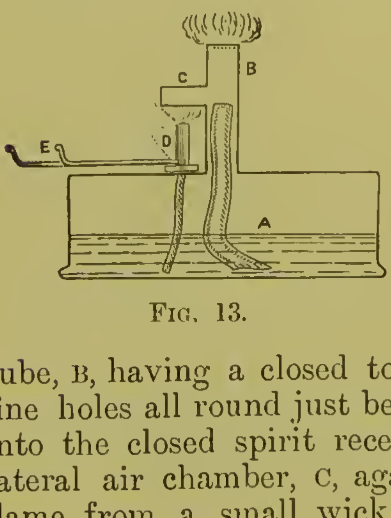

FIG. 13.

can strike. The tube of this wick has attached to it a bolt, E, with a spiral spring, and a to and fro action, which allows of the wick being placed under or withdrawn from the lateral air chamber. The dotted lines show it in position when removed from beneath the air chamber. Further, the wick in the central tube only reaches as far as the air-chamber, C. The action of the apparatus is as follows. When the wick burner, D, is turned, so that the flame strikes the under side of the lateral chamber, C, this latter becomes heated, and the heat being conveyed to the burner tube, B, and thence to the spirit in the wick, spirit vapours will arise therefrom and issue by the small holes at the top of the tube, B, where they will become ignited. When it is desired to regulate the amount of heat to be imparted to the spray producer, this can be done by adjusting the small burner, D, withdrawing it from the lateral air chamber when it is desired to lessen the amount of spirit vapour evolved, and thus diminish the flame, and replacing it when it is necessary to enlarge it. Mr. Chiene writes me that the above form of the lamp is considered the best after the result of a good many experiments. The side box, C, is best made hollow. When solid, it is of course more durable, but it has one fault, that the flame does not fall so rapidly after the small wick is withdrawn, and does not rise so rapidly after the small wick is brought below it. It is not necessary that there should be a hole through it, as the vapour of the spirit will easily become ignited. The to and fro action of the bolt connected with the small tube, D, has been found preferable to the swivel movement, as being less liable to go out of order and more protected. Considerable experience with the above lamp has only confirmed its value, and it is by far the best at present known. Of several other modifications introduced by Matthews Brothers of London in the manufacture of steam sprays, I will speak farther on, when I describe their instruments. I have now, I think, touched on most of the improvements brought out from time to time in connection with the spray producers, and have thus paved the way for a better consideration of the next part of my paper, in which I propose speaking of some of the most approved instruments of the present day.

2. *Account of some of the Present most Approved Spray Producers.*—These may be most conveniently arranged under the three heads of (*a*) hand spray producers, (*b*) foot spray producers, and (*c*) steam spray producers.

(*a*.) *Hand Spray Producers.*—These are very numerous, but in Fig. 14 I give an illustration of one that I know from experience to be a very reliable instrument. It gives out a very satisfactory cloud of spray, and it embodies all the improvements which I spoke of above. Thus, at D, is seen the short indiarubber tube for compressing the air tube, while G is the screw for regulating the size of the liquid. E is the cap for protecting the points, and H is the wire guard for securing the indiarubber stopper while the instrument is in use. It can be obtained from Mr. Gardner, 45 South Bridge, Edinburgh, at a cost of 26s.

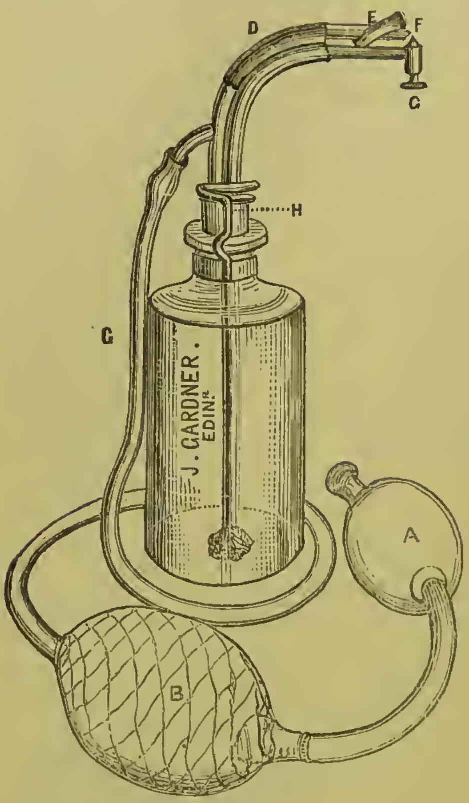

Fig. 14.

And here I may say that it is not necessary for me to describe the method of working to be followed in the case of each instrument, as full directions can always be obtained from the maker of it. All I need do is briefly to bring under notice illustrations of some of the best instruments, with some remarks on their construction and price, and saying where they can be obtained.

Messrs Arnold & Sons, 35 and 36 West Smithfield, London, have recently brought out a patent flexible spray producer for dressing by the antiseptic method. It is shown in Fig. 15. It is fitted with pliable tubes, so that any direction can be given to the atomized fluid, which can also be concentrated or dispersed as required. Being fitted with a tap, the spray can be stopped at any moment. Its price is £1, 1s.

One of the latest form of hand sprays is Fig. 16. It was suggested by Mr. Golding Bird, and is made by Messrs Millikin & Down, 3 St. Thomas Street, London, S.E. It consists of a large bottle of about 40 oz. capacity, carried across the shoulder by means of a strap, thus avoiding the inconvenience of holding a large bottle in the hand, while it also allows of the use of boiling water. This gives a warm spray, and renders it almost equal to the steam spray, for which it is an efficient

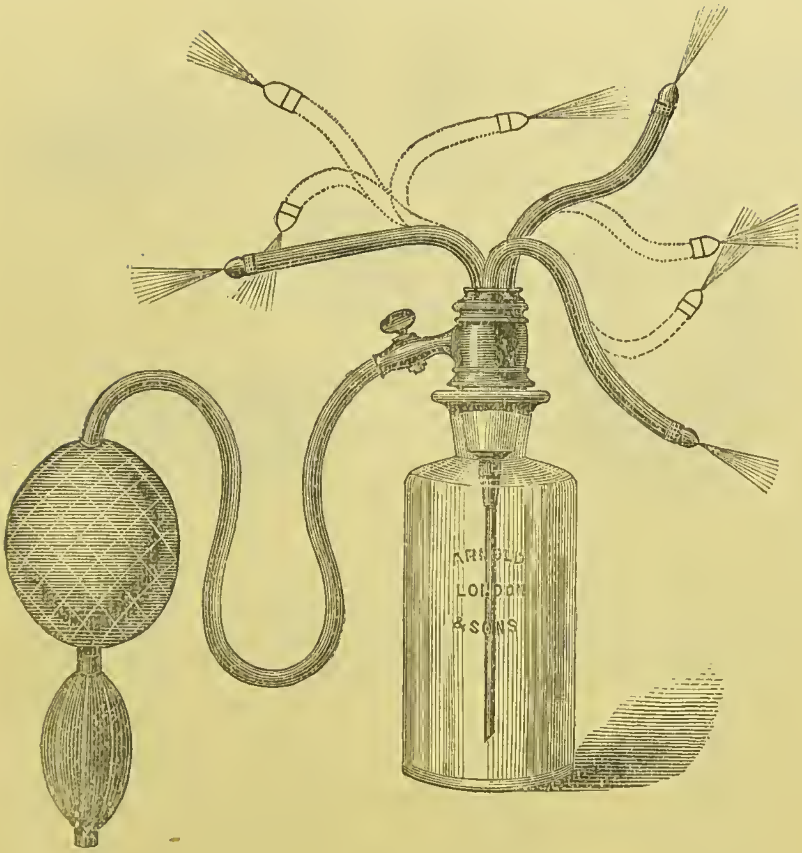

Fig. 15.

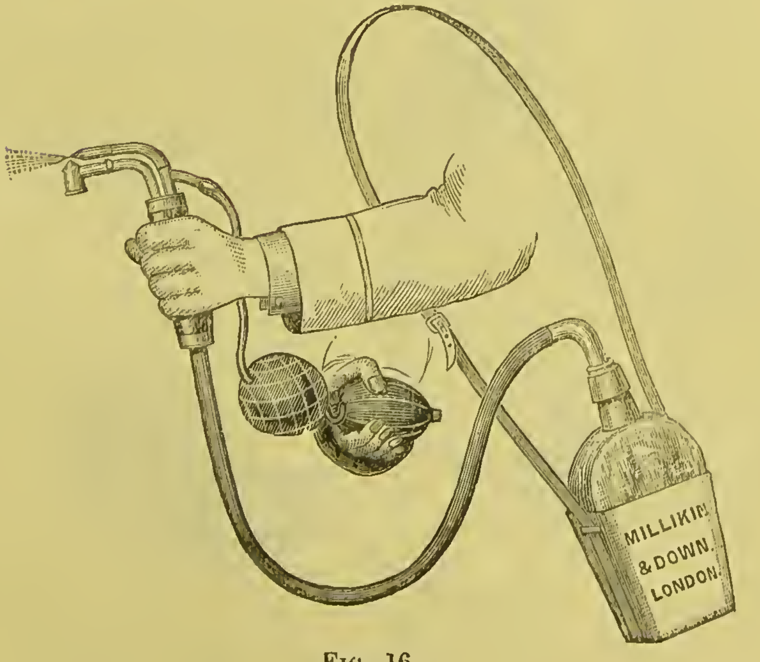

Fig. 16.

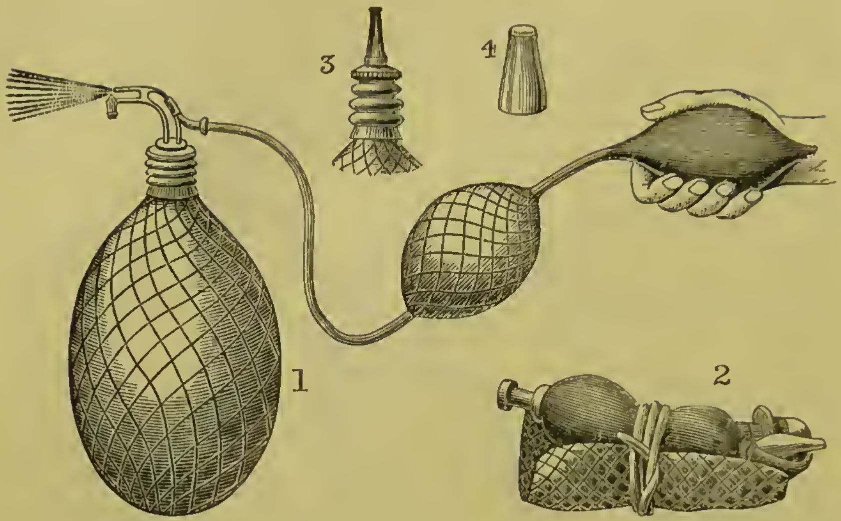

FIG. 17.

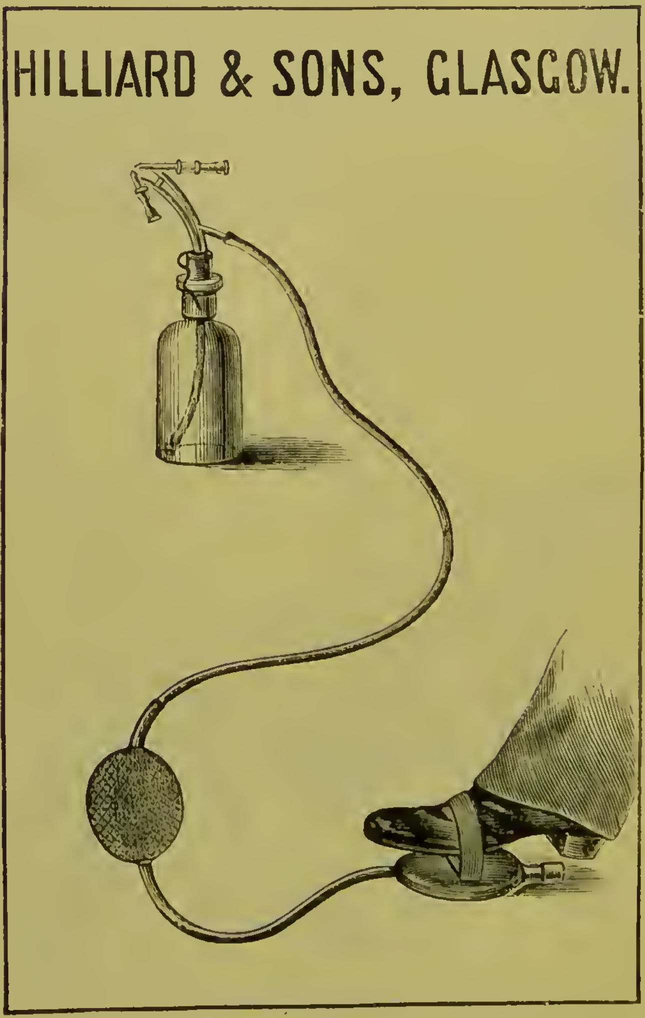
HILLIARD & SONS, GLASGOW.

FIG. 18.

substitute wherever the latter is not at hand. Its price is £1, 17s. 6d.

The only other hand spray I would allude to, is one devised by Dr. Reverdin, of Geneva, and it is so made as to be carried easily in the coat pocket. In the accompanying drawing, Fig. 17, it is shown (1) in working order, (2) packed up for carrying, (3) furnished with a nozzle to act as a syringe, while (4) is the cover for the nozzle when the instrument is packed. It can be obtained, I think, from MM. Collins & Cie., Rue de l'Ecole de Médecine, 6, Paris.

(*b.*) *Foot Spray Producers.*—There are only two of these to which I would allude, and they are both known as Lister's, though they differ in the arrangement of their parts. The one most in ordinary use, Fig. 18, is made by Mr. W. B. Hilliard, 63 Renfield Street, Glasgow, at a cost of 24s. I know it to furnish a good spray. In connection with this instrument I would draw attention to a very useful improvement, which has been suggested by M. Demaureaux of Geneva, for cleaning the spray points should they become obstructed by any particles of dust or grit contained in the solution, a not uncommon occurrence. It is shown in Fig, 18, attached to each of the spray points, and consists of a needle placed inside each point, but kept out of the openings when not in action by a piece of rubber tubing. Should anything obstruct one of the points, pressure with the thumb on the end of the rubber tube pushes forward the needle from within into the opening, and effectually clears away any obstructing particle, and this without interrupting the cloud of spray in any appreciable degree. When the pressure of the thumb is withdrawn, the rubber tubing instantly springs back, carrying with it the needle, which is thus placed ready for action again should the stoppage recur. The arrangement has been found to work most satisfactorily. The other form

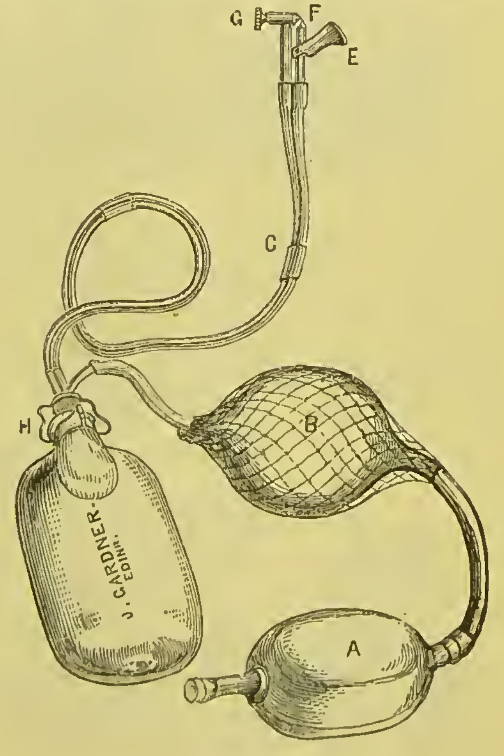

Fig. 19.

of foot spray is seen in Fig. 19, and is constructed that the bottle may be placed on the floor or carried in the pocket, while the long tubes can be guided in any direction needed. It was formerly very much used in Mr. Lister's wards. It is made by Mr. Gardner, 45 South Bridge, Edinburgh, and its price is £2, 2s.

(c.) *Steam Spray Producers.*—As there are several of these to bring under notice, I think the best plan to adopt will be to take them in alphabetical order, thereby facilitating reference. In accordance with this plan the following are the ones I would speak of:—

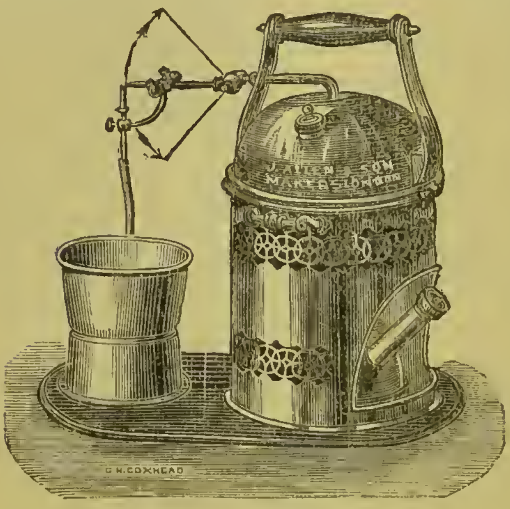
J. ALLEN & SON MAKERS LONDON
G. H. COXHEAD

Fig. 20.

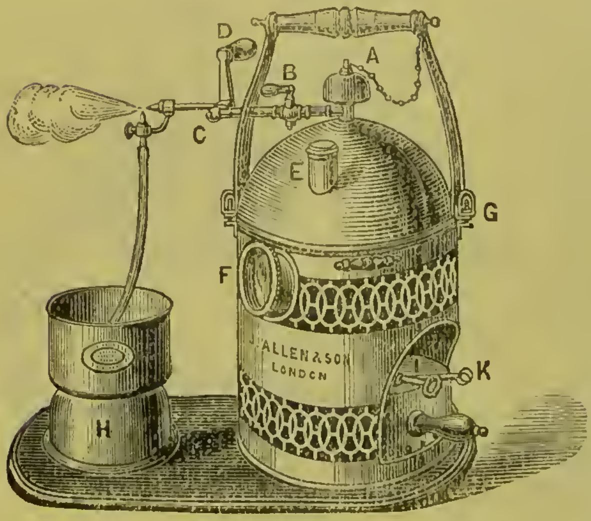

Fig. 21.

(1.) *Allen's.*—Messrs. J. Allen & Son, 64 Marylebone Lane, London, W., are the makers of two forms of spray producers, illustrations of which are here appended. The first, Fig. 20, was suggested by Mr. R. W. Parker, and is a simple and efficient apparatus. It will throw a fine spray six feet, and works for nearly three hours without refilling. The steam jet works on a swivel joint, and can be raised or lowered as required. The steam and suction jets can be screwed out for cleaning or clearing, and each apparatus is supplied with two extra jets. Any glass bottle or tumbler may be used for the antiseptic solution, placed in the receiver in front of the apparatus. It is mounted on an ebonised stand, and measures 7 inches diameter, and 12 inches high to top of boiler. When the boiler is made of tin it costs £3, but when of copper £4. The other instrument, Fig. 21, is constructed on the same principle as the last, but has various improvements added to it, such as a glass disc, F, to show the amount of water in the boiler, a lever, D, for directing the spray with greater facility, and a safety valve, A, which is as safe as it is simple. It is a dead weight of lead, nicely adjusted to the requirements of the operator, and is hollowed on the under side, so that any steam escaping is directed downwards, and not upwards, into the faces of the assistants. The lamp is a very efficient one, but these sprays can be fitted with an atmospheric gas burner in place of lamps, and with an india-rubber tube slipped on from any gas burner they will be found very convenient and economical. The above is called the "Lancet" spray apparatus, and costs £5, 10s. Mr. Archibald Young, 58 North Bridge, Edinburgh, is the agent for Messrs. Allen's goods in Scotland.

(2.) *Arnold's.*—The engraving, Fig. 22, represents a steam spray producer, made by Messrs. Arnold & Son, 36 West Smithfield, London. The boiler is of sufficient capacity to maintain an uninterrupted spray for nearly two hours, and has been tested with a pressure of 100 lbs. The valve is graduated to serve the purpose of both safety valve and

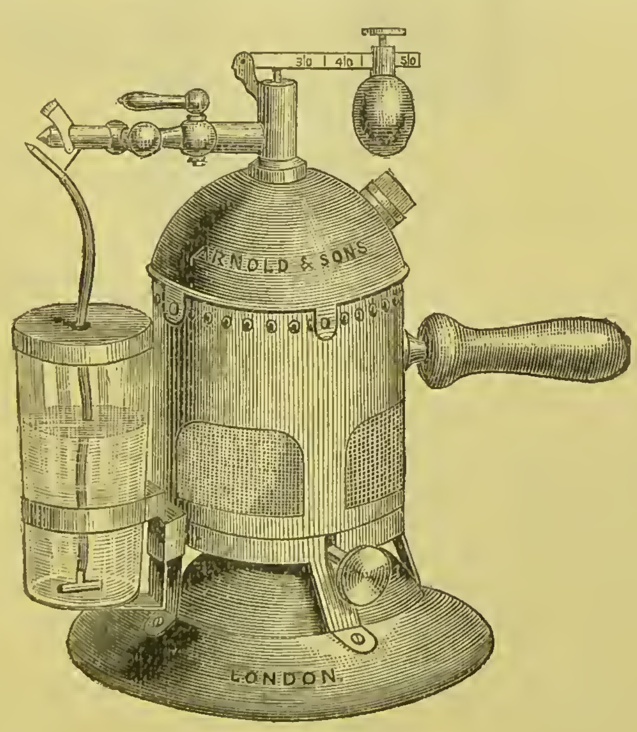

Fig. 22.

pressure guage. The lamp is constructed of as simple a form as possible, and having a circular wick diffuses the heat over the lower part of the boiler, which is globular. The wick can be readily raised or lowered by a rack arrangement connected with the handle. The above instrument costs £8, 8s., but it can be made in smaller sizes at £6, 6s. and £4, 4s. All these sprays are thoroughly tested, and being brazed and not soldered are less liable to explosion.

(3.) *Benham's.*—The illustration in Fig. 23 represents a new form of inexpensive spray producer, devised by Mr. Benham of St. George's Hospital, and manufactured by C. Wright & Co., 108 New Bond Street, London. It is composed wholly of metal, and is provided with an excellent safety valve, A, and glass guage, B, for ascertaining the contents of the boiler, while the handle is of a convenient form for holding. The apparatus is constructed to produce an uninterrupted spray for upwards of an hour, and, being inexpensive and portable, is well adapted for operating and dressing in hospital or private practice. It can be obtained complete in box, with full directions for use, from the above makers, at 15s. 6d.; but if made with copper boiler, stand and lamp, at 30s.

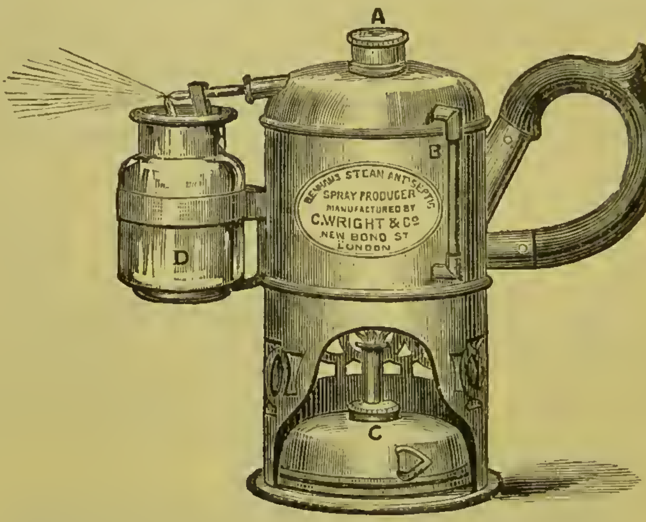

Fig. 23.

(4.) *Gardner's.*—Mr. Gardner, 45 South Bridge, Edinburgh. is the manufacturer of several varieties of steam spray producers, and indeed it was by him that the majority of the original instruments were made for Mr. Lister when he was in Edinburgh. He makes them in three sizes: (*a*) *small*, for changing dressings and short operations, (*b*) *medium*, for operations in private practice, and (*c*) *large*, for hospital use.

As they are all constructed on the same pattern, I will speak only of the large one, which is seen in Fig. 24. It consists of a boiler and spirit lamp, which are completely insulated by means of the non-conducting plates secured to the lamp. The boiler contains 24 oz. of water, and the lamp 18 oz. of methylated spirit. The carbolic acid solution is contained in a bottle attached to the side of the instrument, into which the india-rubber tube, C, dips. The handle is screwed into the side of the boiler. Owing to the construction of the joint, J, steam will issue from it when the spray points, E, are directed forwards towards the patient, but when the points are directed backwards over the boiler towards the person holding the instrument the opening is closed, and no steam issues. The points are protected with a metal hood, and when obstructed they can be unscrewed at K and cleared with one of the soft metal wires supplied with the instrument. The lamp is that of Mr. Chiene, consisting of two tubes, a larger and a smaller, fitted with wicks, that in the former only reaching to the air chamber (6). The larger tube is fastened in position by a pin and slot, and to the small tube is attached a handle, with a to and fro action, by the movement of which the tube can be brought to and removed from the air chamber. The principle of the lamp I have already described. When it is in action, if the small flame is carried away from under the

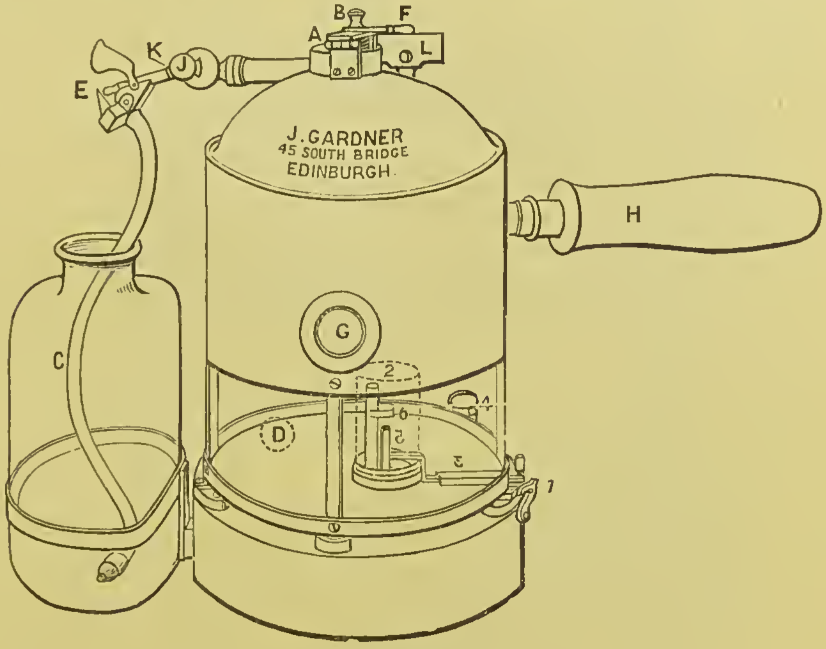

FIG. 24.

air chamber, the central flame then falls, but rises again if the smaller tube is replaced beneath the air chamber. These lamp tubes are protected by a metal cap, which serves as a measure to fill the boiler. If the boiler and lamp are full before commencing, the spray will last upwards of *three* hours, though it may be necessary to refill the bottle with carbolic lotion, and the lamp with spirit, both of which can be done without stopping the spray. The above instrument, with one jet, costs £8, 10s.; with two jets, £9. All Gardner's instruments are brazed, so that they are not liable to explode, and could even be put on the fire without sustaining any damage. They are also tested by Burgoyne's steam gauge up to 50 lbs., and are warranted to work at 20 lbs. pressure. No washers are used in connection with the taps, but they are all ground screw tight.

(5.) *Khrone & Sesemann's.*—Of the different steam spray apparatus made by Messrs. Khrone & Sesemann, 8 Duke Street, Manchester Square, London, W., the first one that I here bring under notice is suitable for hospital work, and will give an uninterrupted spray for from three to four hours. The engraving, Fig. 25, represents the boiler removed from the lamp in order to show the "snuffer lamp," for lighting and extinguishing the spirit flame. The dotted lines show the boiler in position when ready for use. The boiler is made of solid brass, to which the various parts are brased in the fire, a proceeding which renders them most durable and most suitable for hospital use. It is provided with a safety valve, G, a stop cock for steam tube, H, and the spray tube can be elevated or lowered so as to disperse the spray upwards or downwards. When the small wick, D, is lighted, and the snuffers, E E, opened, then the small flame lights the circular wick, the flame of which heats the central tube and converts the spirit into vapour, which escapes from several small holes near the top of the tube, where it must be lighted. When the apparatus is not in use, cap B is placed over the central tube and the small wick to prevent evaporation of the spirit. In this instrument is seen well depicted the snuffers lamp of which I have already spoken. It is not in such general use now as formerly, but the advantage it is considered to possess is, that when an operation is finished the snuffers are closed, and thereby the central light is extinguished, the small wick alone remaining alight; but the central wick can be instantly lighted by opening the snuffers, and thus get up steam. Care must be taken to adjust the central wick around the tube. It should project evenly, and only very slightly, so as to give but a small flame around the central tube. If the flame is too large the snuffers cannot extinguish it. The price of the above described instrument, with one jet, is £7, 7s., and with two jets, £9, 9s.

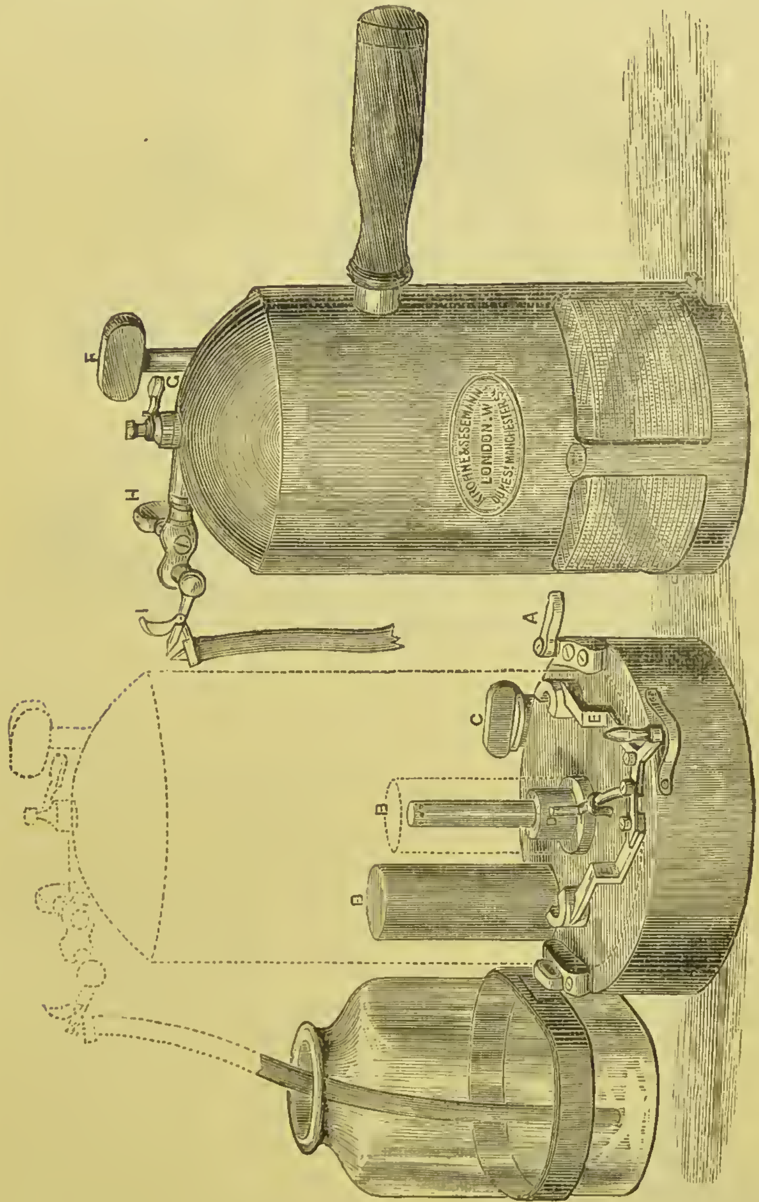

FIG. 25.

Messrs. Krohne & Sesemann write me that they are at present making another form of instrument, with an improved regulating lamp and safety valve. It is constructed in three sizes, at £4, 10s., £5, 10s., and £7, 7s., this last having two jets, and being shown in Fig. 26. The boiler is globular in shape, is brazed, and is tested to 100 lbs. to the square inch. It is supplied with the lever and weight safety valve, the shank of which is graduated to allow of the instrument being marked at a known pressure. The lamp has a circular wick, which can be regulated to a nicety by means of a tube worked by a rack movement. The above instrument will furnish a spray for more than two hours, and is specially suited for hospital work and lengthy operations.

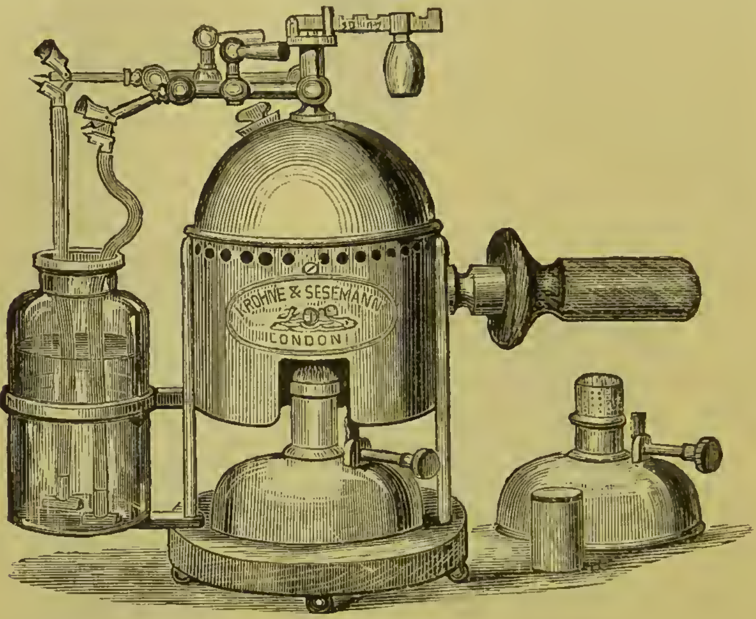

FIG. 26.

(6.) *Marr's.*—Mr. David Marr, 27 Little Queen Street, Holborn, London, W.C., is the maker of four sizes of steam sprays, all similar in construction. Those shown in Figs. 27 and 28 are his No. 3 and No. 4, and are recommended for hospital work. No. 3, Fig. 27, steams 2½ hours, and costs £6, 10s.; No. 4 steams 5 hours, and costs £8, 10s. His No 1, or pocket spray, steams about 1 hour, and costs £5, 5s; while his No. 2, for private practice, works for one hour and a half, and costs £6, 6s. The No. 4, Fig. 28, is provided with double nozzles, costs £8, 10s., and steams for 5 hours. It is useful for such an operation as

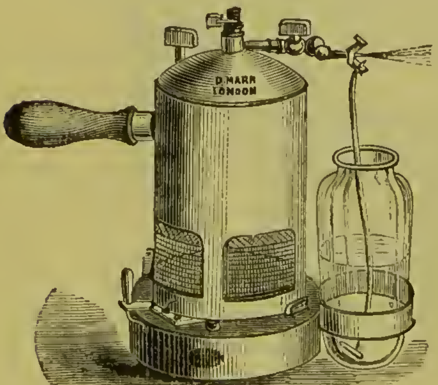

FIG. 27.

ovariotomy. All of these sprays are fitted with lamps of a very simple pattern, owing to the absence of all rack work, and the flame can be moderated at the will of the operator.

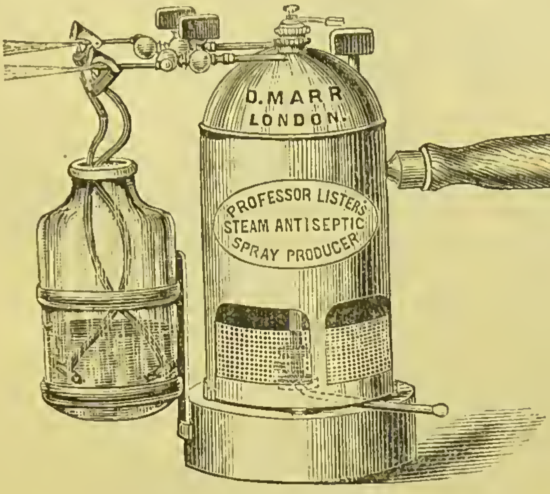

Fig. 28.

If necessary, with these lamps, the water can be kept at *boiling* point for some hours. All Marr's machines are made of the best materials, are constructed under his own personal superintendence, and are thoroughly tested. W. B. Hilliard & Son, 63 Renfield Street, Glasgow, are the agents in Scotland for Marr's goods, and they can be obtained from them.

(7.) *Messrs. Matthews Brothers,* 27 Carey Street, London, W.C., not feeling satisfied with the old pattern steam spray, and regarding it as wrong in theory, have brought before the profession instruments constructed on new and original principles. The following are the modifications which they write me they have introduced:—(1.) The boiler, which is of copper, is *spherical* in shape, and is so framed in a brass jacket as to allow the flame of the lamp to *entirely* cover its lower half, and thus get up steam quickly. (2.) Adoption of the beam and weight safety valve, which is marked off to act as pressure guage. (3.) The lamp is of simple construction, and its flame can be raised or lowered at will. (4.) Complete insulation of the lamp by a wooden stand, thus preventing overheating of the spirit. (5.) Removal of all wire gauze from the lower part of the spray, thus ensuring improved ventilation, and more thorough combustion of the spirit. Fig. 29, which costs £10, 10s., will give an idea of the shape and general construction of Messrs. Matthews' instruments, which are made in various sizes, from £25 down to £3, 10s. At the different hospitals where they are used they have given universsl satisfaction. There is also one other improvement which they have introduced, and that is, attaching to the boiler, as shown in Fig. 30, a powerful influx pump, for the purpose of supplying water to the boiler, so that steam may be generated in a few minutes, and when the spray is once started it may be kept up for an indefinite time, because, when the steam has once been raised, more water may be injected at short intervals, by means of the pump, without stopping the spray. As the principle of the apparatus is extremely simple, and there are no dangers or practical difficulties in carrying it out, the arrangement must be regarded as a most

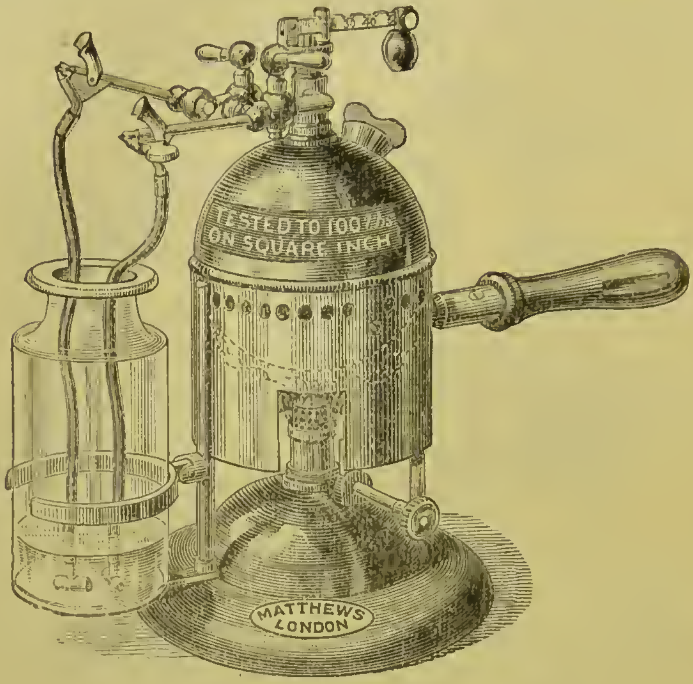

FIG. 29.

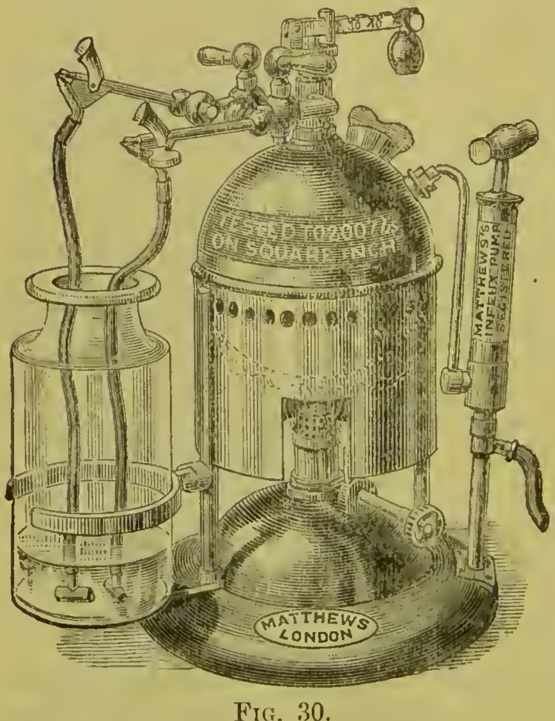

FIG. 30.

satisfactory improvement in the spray producer. The pump can be added to any size of spray at a cost of about £3.

(8.) *Mayer & Meltzer's.*—In Fig. 31 will be seen an extremely simple and easily managed apparatus, made by Messrs. Mayer & Meltzer, 71 Great Portland Street, London, W. It has an improved regulating lamp and safety valve, and is tested to 100 lbs. to the square inch. The boiler is made of stout copper, well hammered and brazed, and is of globular shape, so as to expose a large surface to the flame, and be better adapted to resist high pressure. The safety valve is on the ball weight principle, which is almost impossible to get out of working order, and by adjusting the weight the spray can be worked at a given pressure. The lamp is simple, but gives a large hot flame, which is regulated by a tube worked on a rack movement, and when not in use can be reduced to a minimum. The lamp fits into a wooden stand, which prevents the adjacent metal from becoming unduly heated. The above instrument, made with a single jet, costs £6, and with two jets, £8.

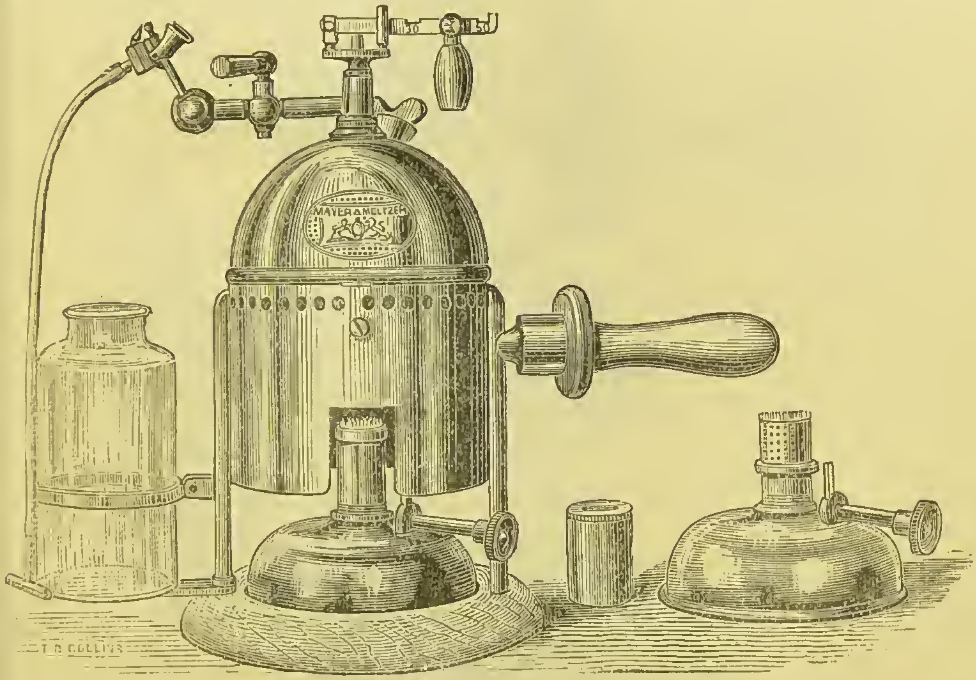

Fig. 31.

(9.) *Millikin & Down's.*—These instrument makers, while they construct spray producers on an expensive pattern, can thoroughly recommend a cheaper and original form of apparatus, Fig. 32, which they consider answers every requirement.

The boiler, which holds 50 oz., is of brass, and spherical in shape, and is hard soldered at each point of union. It is fitted on to a brass rim, which allows of a "ball and socket" motion, and permits the spray to be sent in any direction. Upon full pressure being attained in the boiler, the spray is thrown out a distance of about 6 feet, and can be maintained for about two hours. The lamp is furnished with a circular wick, and it can be raised or lowered by means of a collar, which regulates the position of an outer tube. The spray is supplied on a stand, as illustrated, but can be had with a portable tripod. Some minor alterations have recently been introduced into this instrument by the makers, such as an improved handle, and the omission of the hood covering the points, but they are merely small matters of detail. The instrument costs £4, 10s., and can be obtained from Messrs. Millikin & Down, 3 St. Thomas Street, Borough, London, S.E.

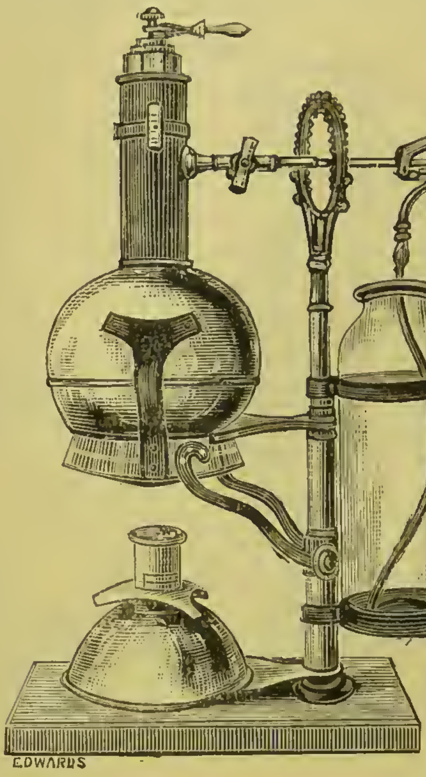

FIG. 32.

(10.) *Young's.*—Mr. Archibald Young, 58 North Bridge, Edinburgh, has made antiseptic spray producers for several years, and Fig. 33 shows a steam spray, made somewhat after the old pattern, yet in every respect a very handy and efficient instrument. It is suitable for hospital work, and costs £5, 5s. In addition, however, he manufactures sprays with all the latest modifications, as improved lamp, and insulated boiler, and he does so in three sizes—*small portable*, £6; *medium*, £6, 10s.; and *full sized hospital*, £7; as well as in the small useful form seen in Fig. 34, at £2,10s. Mr. Young also makes a hand spray producer, similar to Fig. 14, at a cost of £1.

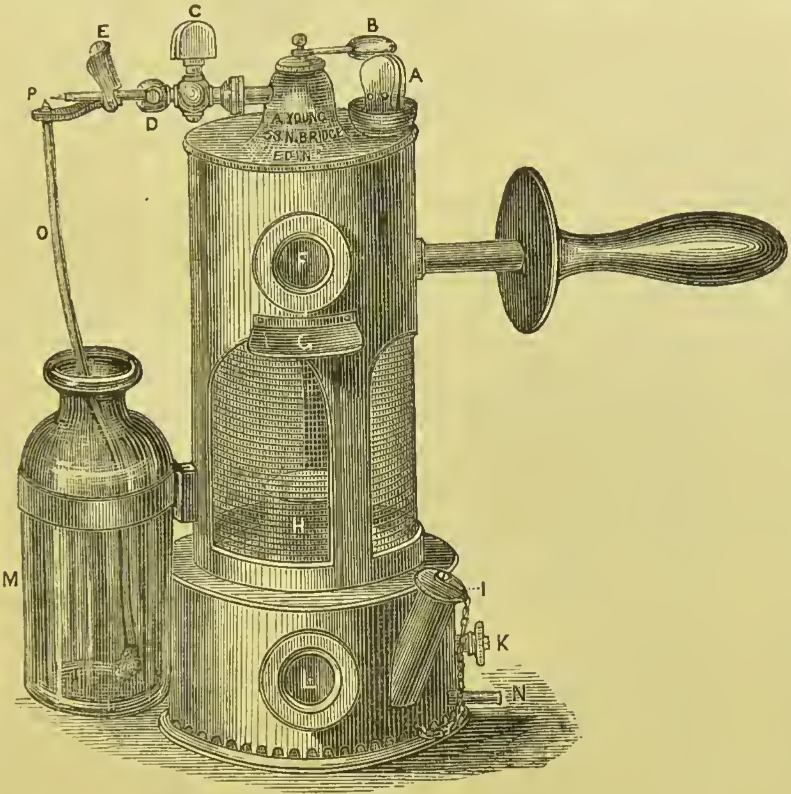

Fig. 33.

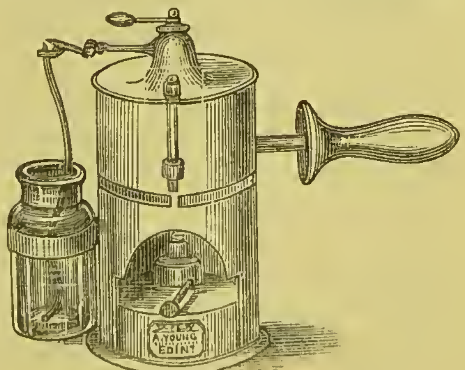

Fig. 34.

The instruments furnished by any of the above firms may be relied on as of good material and workmanship, and as furnishing a satisfactory spray. I may also say that, if desired, any of the above instrument makers will furnish sprays nickelled or platinum bronzed, the former process costing about one guinea. Cases, too, can be got for holding the sprays and carrying them about. They may be japanned, as made by Messrs. Matthews, at a cost of 8s. 6d., or they may be of wood covered with leather, and more expensive. Lastly, I would mention that sprays can be hired out to surgeons for operations, and to families if they have cases needing their use. Mr. Gardner, 45 South Bridge, Edinburgh, follows this plan, the terms being very moderate, and depending on the time the spray is needed.

The above by no means exhaust the list of instruments made, as every instrument maker, both at home and abroad, constructs his own on the plan he thinks best. Thus, we have what are termed the "Copenhagen Sprays," made by Ramussen of that town; and in Germany we find Professor Nussbaum employing an apparatus driven by compressed air, and Professor Thiersch one worked by hydraulic power. The limits of this pamphlet will not allow me going into any account of these; and I would in conclusion show, in Fig. 35, an illustration of the apparatus recommended by Dr. Lucas-Championnière in his book on *Antiseptic Surgery*, and made by MM. Collin & Cie., Rue de l'École de Médecine, 6, à Paris. It can be obtained of two sizes—one, which works for two hours, costing 100 francs, while the other has two jets, works four to five hours, and costs 150 francs.

3. *Remarks on the Selection and Management of Spray Producers.*—Commencing with the hand or foot instruments, the first point needing attention is the strength of the carbolic solution to be placed in them. This should be the 1-40 watery solution. As Mr. Lister says:—"A solution of the strength of 1 to 40 is that which I would advise for providing an antiseptic atmosphere in the form of spray, when the particles of the liquid are dispersed by means of air impelled by hand bellows or a condensing pump." (*Lancet*, 13th March, 1875.) In working these instruments, the way to maintain a satisfactory cloud of spray is to compress the caoutchouc tube against the side of the bottle, and then fully and frequently work the hand or foot ball until the second ball, which acts as a reservoir, and is covered with a netting, is completely distended. If this is done at the commencement, the distension of the second ball is kept up by less frequent compressions, and the fatigue of working is considerably lessened. Another point of some importance is to regulate the jet of liquid according to the volume and coarseness of the spray required. This is best accomplished by compressing with the thumb the piece of short india-rubber tubing on the air tube and regulating by means of the screw at the end of the water tube the size

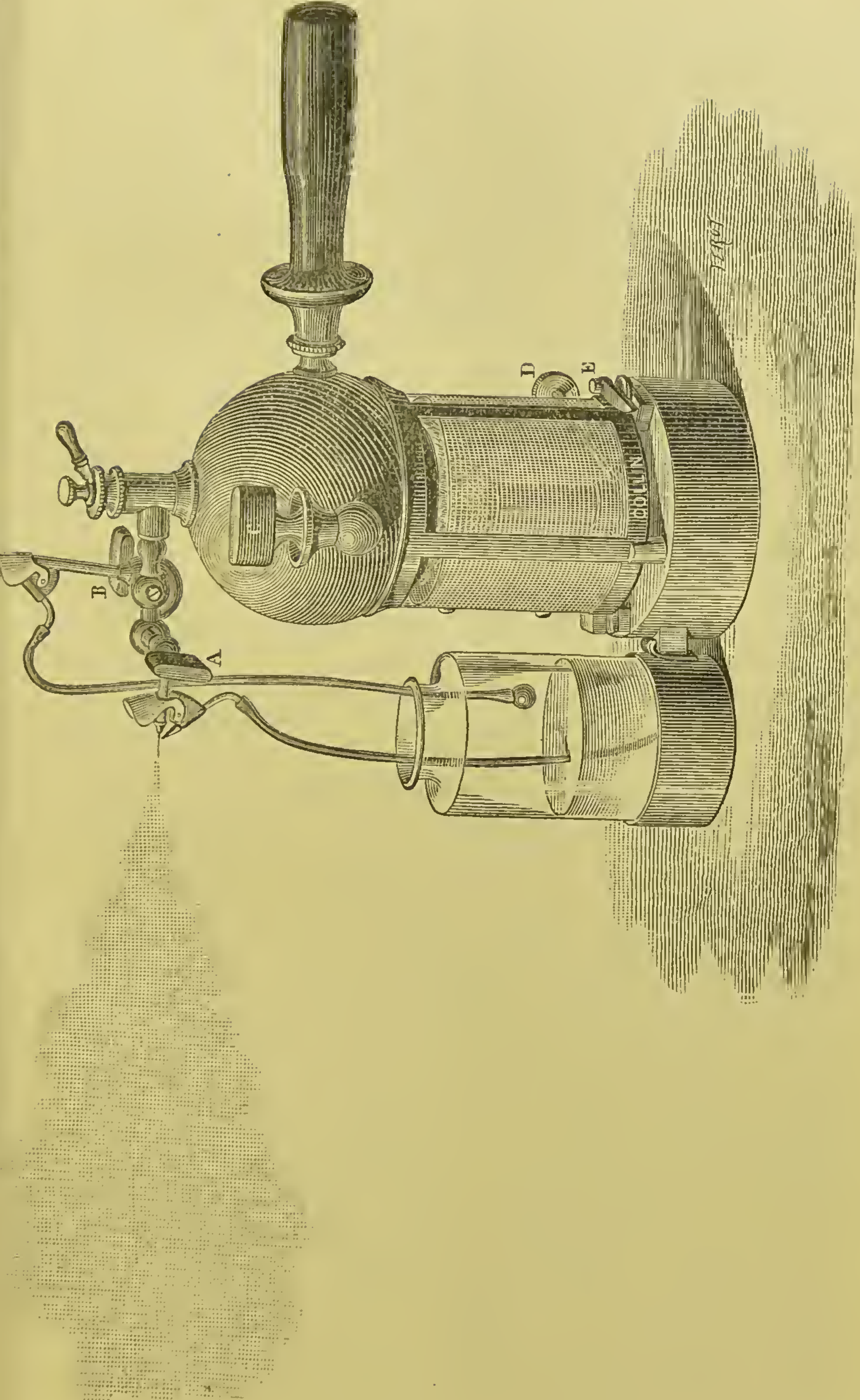

Fig. 35.

of the jet of liquid. Owing to the fineness of the points of the tubes, they are apt to become blocked by any particles of dust or dirt present in the air or water, hence it is very necessary to have the lotion used for the sprays filtered, and also to place in the end of the water tube a bit of sponge to arrest such particles. The sponge should be kept in position by a bit of gauze, and should be changed at intervals. Should the points become blocked, the tubes should be removed from the bottle, and one of the fine needle wires supplied with every instrument should be passed through them *from within.* To enable this to be done in the case of the fine end of the water tube, a modification in its shape was carried out, which is thus described by Mr. Lister:—"Then it was necessary to provide some ready means of clearing the fine end of the water tube, in case of its obstruction by particles of dust. This is done by having the water tube straight for a short distance from the nozzle, and then bent at a right angle, with a little milled cap to screw on at the angle, so that in case of obstruction the cap is screwed off, and the orifice of the water tube is cleared at once with a needle or a bit of fine wire." (*British Medical Journal*, 26th August, 1871.) These remarks will be made clearer by referring to Fig. 12, where D is the short tube to be compressed for regulating the size of the jet, and G is the milled cap which can be unscrewed. The hood, E, should always be put down over the jets, F, to prevent them being injured. In using the spray for changing dressings it is always most important to lift up the corner of the dressing nearest the spray, so that the cloud may be directed *into the angle between the dressing and the skin*; and here I may say that sometimes it may be necessary to stop the spray when a wound is uncovered and exposed to the air. Under these circumstances, Mr. Lister advises the use of what he terms the "*guard*"—"a piece of rag dipped in the 1 to 40 watery solution of carbolic acid." This should be placed over the wound, and then "the spray can be removed with security." Care should be taken that the rag composing the guard is made of sound calico, with no holes in it; and, when it is desired to remove it, the spray should be first made "to play on the part during the exposure of the wound until the permanent antiseptic dressing is re-applied." (*British Medical Journal*, 26th August, 1871.) The points, then, that require attention, in connection with hand and foot sprays, are the following:—(1.) The use of 1-40 carbolic lotion. (2.) Proper distension of the hand or foot ball apparatus before commencing. (3.) Regulation of the size of the jet of fluid. (4.)

Insertion of a bit of sponge to act as filter in the water tube. (5.) Careful removal and cleaning of the jets from within with a fine wire should they become obstructed. If these matters are attended to, it will be found that these instruments have a good deal to recommend them. Thus, they do not get out of gear, they are very serviceable for changing the dressings in ordinary cases, being always at hand, and they are not expensive. The great objection to them is that they require considerable practice to work them without being fatigued, and that they necessitate the presence of an assistant. This is not so powerful an objection to them in hospital as in private practice, yet it seems to have weighed with Mr. Lister in making the change to steam sprays; for, speaking of sprays, he says:—" But I have of late found it more convenient to use high pressure steam as the motive power, on the principle of Siegle's steam inhaler, the apparatus, modified to adapt it for our purpose, being both self-acting and self-directing, so as to dispense with the services of an assistant. (*Lancet*, 13th March, 1875.)

In the second portion of my paper I have indicated the modifications alluded to, and have given illustrations of some of the instruments made by the best makers, so that I need say no more upon that head. Each one can select for himself the apparatus that he prefers. There are, however, some details that I think should be present in every instrument, to insure its being efficient, and these I will mention now:—(1.) The boiler should be dome-shaped, as being the strongest form, and because this shape allows more surface to the flame for *maintaining the pressure of the steam,* and so steadying the jet of spray. (2.) The boiler should by preference be of brass, as copper is too heating, and it should be completely insulated from the lamp by means of non-conducting plates. (3.) In constructing the boiler, it should be brazed, so that if the lamp be inadvertently applied while it is empty, there is no solder to melt. (4.) The aperture for filling the boiler should not be at its summit, but on a lower level, so as to leave a space clear for the steam, where it may become somewhat dried, and also to obviate overfilling the boiler. If this last takes place, when the steam is turned on a jet of scalding water is ejected, and the steam point may be blocked by solid particles being washed into it by the water. (5.) Every boiler should have a good safety valve, made either with the ordinary spring, or with the lever and weight. (6.) There should be a glass window in the boiler to show when the water is down and needs replenishing. (7.) The lamp should be simple in construction, and should allow of its being easily raised or lowered without completely extinguishing it, thus allowing of steam being kept up when the spray is not actually in use. (8.) The spray points should be protected by a metal hood, and there should be an arrangement for altering the incidence of the spray, so that it may be directed upwards or downwards as needed. (9.) Two jets to a spray are advantageous, as they allow of a larger cloud being obtained if required, and of the spray being kept working should one set of points become obstructed. This end may equally well be attained by having a set of spare points for screwing on in case of any stoppage. (10.) It is better to have the carbolic point united to the steam point at an angle of forty-two degrees instead of at right angles, as it prevents the fluid collecting in drops on the point of the carbolic tube, and thus ensures more perfect volatilization of the acid. (11.) The antiseptic cloud thrown by the spray producer should not only be a large one, but it should also be in a state of very fine division, so as not to be wetting in character. (12.) A spray producer, to be serviceable, should not only work for a considerable time (say two hours) without needing replenishing, but it should do so at a much lower pressure than that for which the instrument was tested, so as to be free from all danger of explosion.

Having then selected a spray, and having borne these points in mind, the next thing is to manage it; and before I allude to the matters that require attention, I would say let every one make himself thoroughly acquainted with the mechanism and structure of the apparatus he is going to handle before he attempts to set it in working order. The reason why steam sprays get out of order sô frequently is, that they are handled by those who know very little about their arrangement and construction, and won't take the trouble to learn. In private practice each surgeon looks after his own instrument; but in hospital work it is different, and I believe that the best plan is to appoint a clerk or dresser to have charge of the sprays, and be responsible for their proper working, or else this duty might be handed over to the sister in charge of the ward. I know instances where this latter arrangement was made, and it was found to answer very well. In the working of a steam spray the following directions should be followed out:—(1.) The strength of the carbolic lotion employed with a steam spray should be filtered 1-20. This, mingling with the steam, yields a vapour consisting of one part of carbolic acid to about thirty parts of water, which is a reliable spray. That is the strength Mr. Lister advises. "The spray consists of the 1-20 solution of carbolic acid mixed with the vapour of boiling water." (*Dublin Journal of Medical Science*, August, 1879.) (2.) To save time in getting up steam, use clean hot water. (3.) Fill the boiler up to the base of the dome, never above it. (4.) Allow about 12 oz. of water for each hour's use. (5.) Before lighting the lamp always see that there is sufficiency of spirit in it. (6.) Steam may be considered up when, on opening the stop-cock, it rushes out for a considerable distance and is of a blue colour. (7.) As soon as the suction tube is placed in the carbolic acid, the spray should change from a blue to a white colour. This is the indication that we are dealing with a spray containing carbolic acid, and not steam alone. This is a matter of considerable importance and should always be attended to. Besides the colour, we have also the rushing sound, the smell, and the taste to guide us in ascertaining the presence of carbolic acid in the spray. (8.) See that the tube which conveys the solution has a piece of sponge in it to filter the fluid and prevent the fine steam point being blocked with any particles. (9.) When steam is up, press upon the lever of the safety valve to see that it is working properly. (10.) If the spray is working well and much steam escapes from safety valve (unless it is out of order), it shows more is being made than is required, and the flame of the lamp should be lowered. (11.) If much steam escapes from safety valve, and there is no pressure to cause suction at the jet, it will at once show that the jet is choked, and the lamp should be lowered and steps taken to remove the obstruction. (12.) The best way to remove any obstruction is to unscrew the points and pass through them, *not pins*, but a horse hair or fine metal wire. It is on occasions such as this that the value of two jets to the spray, or of having a spare pair of points to affix is seen. (13.) On the slightest threatening of the spray going wrong, place on the wound the "guard" properly soaked in carbolic lotion. (14.) During an operation one person should be told off to attend to the spray, and he should see that the antiseptic cloud envelops the wound, does not incommode the surgeon, or play upon the patient's mouth, so as to necessitate its being respired. He should also see that there are no draughts from open windows or doors to blow the spray about, and that the spray bottle is replenished with carbolic lotion from time to time. Should ether happen to be the anæsthetic, he will avoid bringing the lamp near it in case of igniting it. (15.) When the spray is no longer needed, the lamp should be extinguished, the superfluous steam blown off, and the boiler emptied, care being taken not to let the water flow into the steam pipe. Such I regard as the chief matters of detail to be attended to in dealing with the steam sprays, and if they were carried out and these instruments no longer regarded as innocent toys, but as complicated and important pieces of mechanism requiring care and intelligence on the part of those dealing with them, we should no longer have the haphazard performances that occur so frequently and mar the safety and quietness of an antiseptic operation. I know many objections have been urged against the spray, and some have tried to do without it, but its necessity is now clearly recognised, if we want *certainty* in our cases, and the objections have been found more or less groundless.

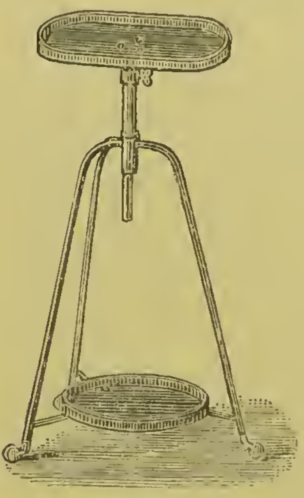

FIG. 36.

During the conduct of an operation or the changing of dressings, it is customary to place the spray on a table or any other article of furniture, but Messrs. Allen & Son, 64 Marylebone Lane, have constructed, at the suggestion of Mr. Berkeley Hill, a very convenient table for holding the spray. It is seen in Fig. 36. It is mounted on castors, and at the lower part between the legs is a tray for holding bottles, &c., while above is a tray into which the stand of the instrument is securely fixed. This upper tray can be raised or lowered to the height required for the operating table or for dressing beside the bed. It can also be turned horizontally in any direction. The stand can be wheeled from bed to bed, or ward to ward without any noise, as the castors are covered with india-rubber. Those who have tried it speak of it as being very safe and useful. Its price is forty shillings—japanned. In the Western Infirmary, Glasgow, they use in the operating theatre a very similar stand, only it is made of wood and is not so handy.

This brings me to the end of my paper on the spray producers used in Lister's system, and I think I have omitted nothing of importance. Undoubtedly, the method of dressing is somewhat complicated, and necessitates the surgeon or general practitioner carrying about with him a variety of things. From time to time surgeons have had constructed for their own immediate wants a case to hold these different articles, but they have not specially devised anything that they have thought worthy of bringing under the general notice of the profession. Very recently, however, a surgeon's and general practitioner's bag, for the practice of antiseptic surgery, has been designed by Mr. O. D. Marriott, of Sevenoaks. The accompanying illustration, Fig. 37, indicates the combination of a tin case and leather bag, so arranged that the former contains steam spray apparatus and all the materials required for antiseptic practice, such as carbolic acid and carbolised gauze, which requires an air-tight enclosure to ensure its keeping its strength. This case glides into a compartment of the bag and is secured by straps, a false bottom forming the roof of this compartment, while the space above is available for instruments and dressing materials, which are not of a volatile character, such as boric lint, protective, &c. Its dimensions are 16 in. by 10 in., and greatest height 12 in. In Fig. 38 is seen the tin case with a steam spray. The bag with tin case is made by Messrs. John Pound & Co., 81, 82, 83 Leadenhall Street, London, E.C., where one can be seen. Its cost by itself is £3, 5s., but if fitted up with all requisites and with a steam spray of full size, made by Marr or Matthews, about £10, 12s. It may be mentioned that the bag has been submitted to Mr. Lister, and has met with his cordial approval.

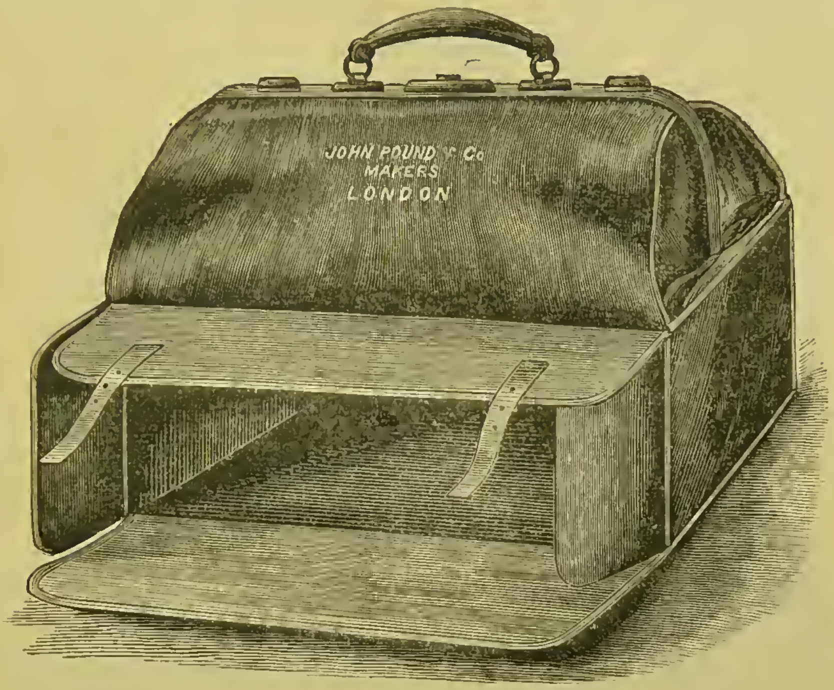

Fig. 37.

To recapitulate, then, in conclusion, I would direct attention to the following points:—

(1.) There are two methods of atomising liquids containing substances in solution.

(2.) One method is founded on mechanical division of the fluid into minute particles by forcibly impelling it against a resisting substance.

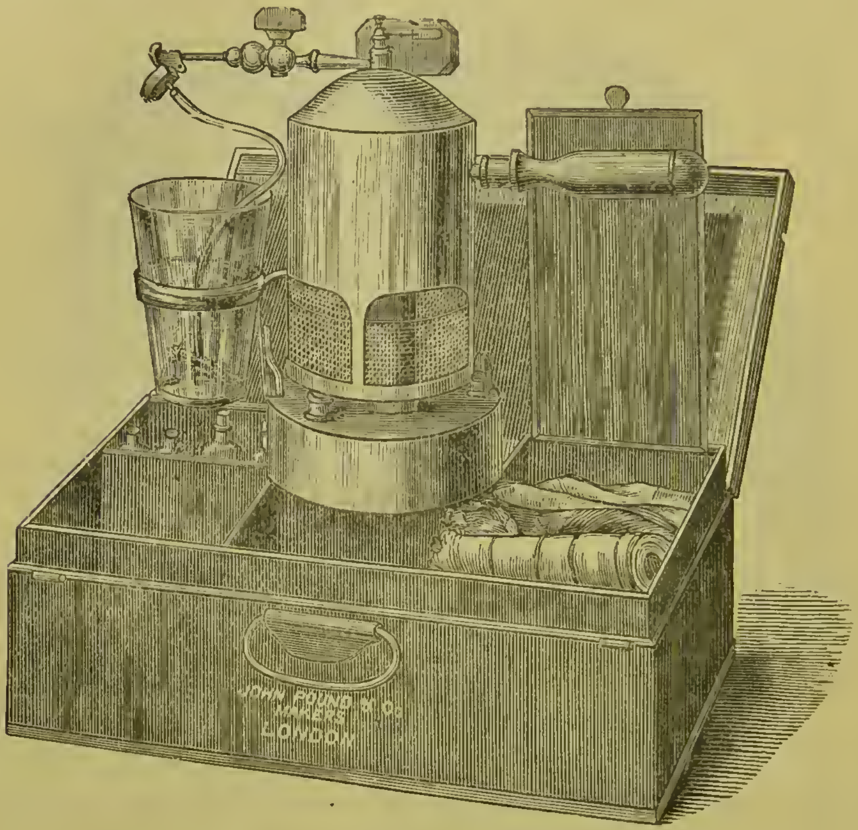

Fig. 38.

(3.) The other method is to incorporate the liquid to be divided with a jet of air driven through a narrow orifice.

(4.) M. Auphan was the first to try the mechanical plan, but the idea received considerable development in the *portable inhalation apparatus* of Sales-Giron.

(5.) Mathieu of Paris, on the other hand, was the first to illustrate the second plan of pulverising fluids, he having brought out an apparatus for this purpose driven by compressed air.

(6.) The next important improvement in Mathieu's idea was made by Dr. Bergson of Germany, who introduced his glass tubes placed at right angles one to the other, and worked by a hand bellows.

(7.) This was followed two years afterwards by Dr. Siegle substituting steam for atmospheric air as the motor power for working these Bergson's tubes, the idea being patented.

(8.) Dr. Waldenburg had previously, however, suggested the use of steam for pulverising fluids, but it is uncertain whether Siegle was aware of his publication.

(9.) Bergson's apparatus has been modified in several ways, and forms the basis of Clark's, Dewar's, Richardson's, and other spray producers, though it is right to say that by some Clark's instrument is held to have been the first ever furnished with *double hand bellows*, and so able to furnish a *continuous* spray.

(10.) At first Mr. Lister employed in his system a spray cloud furnished by instruments on the model of Richardson's, worked by hand or foot bellows.

(11.) With a view of obviating the necessity of an assistant to work the spray, he utilised Siegle's steam spray for furnishing an antiseptic atmosphere.

(12.) To meet however the requirements of surgical work it was found necessary to construct larger instruments.

(13.) These large antiseptic steam sprays are very serviceable, but they require care and intelligence in their management.

(14.) A very convenient bag for carrying about the *materia antiseptica* has been devised by Mr. Marriott and approved of by Mr. Lister.

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